

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) DUPLICATING PROCESS

(71) We, RANK XEROX LIMITED, of Rank Xerox House, 338 Euston Road, London, N.W.1., a British company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for recording information onto a copy sheet. More specifically, the invention relates to a copy duplicating system for producing high quality, high volume copy at relatively low unit cost.

Various systems are well known for high volume duplicating of copies including mimeograph, spirit duplicating, lithography, and the like. At the same time there are known reproduction systems generally regarded as more suitable for lower volume rates such as xerography and photography which offer the distinct advantage of an optical input in reproducing copy of an original.

According to the present invention, there is provided an image duplicating process comprising the steps of forming a magnetic image pattern of permanently magnetized marking material, or of magnetizable marking material which is then magnetized, on the surface of a first support member, and subsequently using the magnetic field derived solely from said magnetic image pattern to attract magnetically attractable marking material towards said magnetic image pattern into image configuration either on a second support member which is brought into contact with the first support member, or directly on the image pattern on the first support member for transfer to the second support member.

For a better understanding of the invention disclosed, reference is had to the following detailed description of exemplary embodiments of the invention which is to be

read in conjunction with the accompanying drawings wherein:

Fig. 1 (a-e) illustrates a series of sequential steps in accordance with one embodiment of the invention;

Fig. 2 is a schematic apparatus embodiment for automatically performing the process in accordance with Fig. 1;

Fig. 3 (a-f) illustrates a series of sequential steps in accordance with a second embodiment of the invention.

In accordance with the first embodiment hereof there is at least partially employed the process of xerography as for example disclosed in Carlson's U.S. Patent Specification No. 2,297,691, which may include variations thereof for placing a developable image charge pattern on a support, as disclosed, for example, in U.S. Patent Specification Nos. 2,825,814; 2,919,967; and 3,015,304. Likewise a latent magnetic image could be formed and utilized as disclosed in U.S. Patent Specification No. 2,857,290. As first taught by Carlson a xerographic plate comprising a layer of photoconductive insulating material on a conductive backing is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the plate area in accordance with the radiation intensity that reaches them, and thereby creates an electrostatic latent image on or in the photoconductive layer. Development of the latent image is effected with an electrostatically charged, finely divided material such as an electroscopic powder that is brought into surface contact with the photoconductive layer and is held thereon electrostatically in a pattern corresponding to the electrostatic latent image. Hereafter, the developed xerographic image may be affixed directly to the surface on which it is developed or as usually performed, is transferred to a secondary sup-

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port on which it is affixed by any suitable means.

In accordance with the embodiment of Fig. 1 there is first formed, as shown in Fig. 1A, a charge pattern of copy to be reproduced represented by the plus signs 10 on the surface of a support 11. Support 11 may comprise a photoconductive layer 12, on a conductive substrate 13, that has been xerographically processed as described above.

Whatever technique is employed initially for forming the latent image pattern, it is subsequently developed by means of a developer material 15 contained in a hopper 16 having an outlet 17 from which the developer cascades over the charge pattern to effect development and then into a receiving bin 18. The developer marking material, as will be understood, is critical to the invention to the extent that the developed image must per se comprise a permanently magnetized material, or material which can be readily magnetized at some step in the process subsequent to development. Accordingly, the developer marking material can comprise various known materials usable in the xerographic art having magnetic or magnetizable components with or without an electroscopic coating, and capable of being attracted to an image pattern of electrostatic charge or magnetic fields. For these purposes, therefore, the developer can include suitable materials such as those described in U.S. Patent Specifications Nos. 2,846,333; 2,970,299; 3,093,039; 3,106,479; 3,155,531; as well as such other developers known to those skilled in the art.

After development the developed image, designated 20, is transferred to a secondary transfer sheet 21 to effect an image reversal from that developed and comprises the master pattern as will be understood.

Where an image reversal is unnecessary, depending on the optical input or other approach to forming the developable image pattern, the primary support 11 can in some instances comprise the master pattern and the transfer step eliminated. This is particularly so where support 11 comprises a consumable product such as well known forms of zinc oxide photoconductive papers.

In the embodiment shown, transfer is effected as shown in Fig. 1C by means of a corona generator 22 that is driven via axial screw 23 to apply an electrostatic transfer charge onto the rear surface of the transfer sheet. After transfer the transferred image is fused to the master pattern by means well known in the art as by application of heat from a fuser 27 including a radiant coil 25 energized from a power source 26.

The master thus formed can be employed for effecting subsequent copy duplication and for this purpose is mounted upon a

continuously driven cylindrical drum 29. A magnetic member 24, which can comprise a permanent magnet or an electrically or electronically controlled magnetic field member supplies a magnetic field to the image to effect a magnetization thereof. As the drum is rotated, a copy sheet is fed via a feed mechanism 31 from a paper supply contained in a tray 30. The top sheet of the stack is continually fed onto a set of drive feed rolls 32 for passing the sheet in contact and in register with the image pattern 20 on the master sheet to be advanced in conjunction therewith.

As the copy sheet 33 advances over and in contact with the master sheet 21, the top side thereof is brushed by a development brush assembly 36 receiving developer particles 37 from a hopper 38. The developer particles may be similar to those employed initially in the preceding steps of forming the master and generally comprise a magnetic powder or magnetically attractable powder such as iron particles in a plastic coating. The particles retained on the brush surface are attracted to the top side of the copy sheet in image configuration as a result of the magnetic field emanating from the polarized image on the master below. This then forms a direct duplication of a master pattern on the copy sheet 33 which then passes below a fuser 27 as above before depositing into a collection bin 40. Thus, with each rotation of drum 29 a copy sheet 33 is fed from the stack in tray 30 into development position in register with the master pattern 21. This therefore enables a high volume high speed duplication of the master pattern. The polarized characteristics of the image enables substantial quantity duplication since wear on the master is less significant than with other known duplicating processes.

Referring now to Fig. 2 there is schematically shown an apparatus embodiment for continuous automatic operation of the aforesaid steps described in connection with Fig. 1. The components for forming a charge pattern of a document 41 to be duplicated is similar to that disclosed in U.S. Patent Specification No. 3,076,392. The document original is placed on a support tray 46 from which it is fed onto a conveyor 47 whereat it is reflected into an optical system 48 for projection onto the precharged surface of a continuously rotating drum 42. As the drum surface advances the electrostatic latent image of the document formed on exposure passes through a developing station 49 whereat developer material 15 as above is caused to cascade over the drum surface to effect image development. After development, the developed image is transferred to a continuous web or master sheet 21 supplied from a reel 51 to pass in contact with the drum surface in the vicinity of corona

generator 22. As before, the image is rendered permanent by fuser 27 and magnetized by magnetic member 24. Thereafter, the web advances past a plurality of separate duplicating stations 52a to 62n until passing onto a takeup roll 53 being driven by a motor 54.

Each of the duplicating stations designated 52a to 52n is adapted to reproduce each of the master patterns contained on web 21. Each therefore includes a supply of continuous copy web material 56 advancing from a supply reel 57 over a pair of guide rolls 58 and 59 between which it passes in register with the advancing master pattern 21. As in Fig. 1e, the top surface of web 56, while within the image field in contact against the master pattern, receives a quantity of developer 37 from a brush unit 36 to effect an image duplication thereon. The web then passes below fuser 39 onto the takeup roll 60.

In Fig. 3 there is shown a series of steps in accordance with the second embodiment of the invention, in which an original document 70 is prepared on an ordinary typewriter 71 using a specially prepared ribbon 72. The ribbon is prepared having an ink containing particles impregnated therein which can be magnetized. Various forms are known in the art including those used conventionally in magnetic ink character recognition characters and suitable inks disclosed in British patent 882,138. This document comprises a master from which subsequent copies could be made in the manner of Fig. 2.

The original document 70 thus formed is then placed on support 73 as shown in Fig. 3b. The master image on document 70 is then magnetized by passing magnet 74 across the surface and the image is dusted with a developer similar to that described above. The developer adheres restrictively to the document surface in the image character or magnetized areas. In order to obtain a reverse reading or mirror image for subsequent duplicating the layer of developer or powder is transferred from the document sheet 70 to a developer receptive secondary support 75 via a pair of driven pressure rolls 76 and 77 as shown in Fig. 3c. The transfer can be effected by either using a secondary support 75 which has an adhesive surface or by attracting the particles to the surface by magnetic attraction. The image may then be fused to the surface of sheet 75 and magnetized in the same manner as described above. Thereafter the sheet 75 is a master sheet which may be wrapped onto the periphery of a drum 29 for continuous rotation therewith. The drum advances the image pattern into contact with a developing brush 36 which presents developer particles 37 to the image. The particles 37 are attracted to and loosely adhere to, the image areas by magnetic attraction. As the drum advances

further, a copy sheet 33 is fed from the top of a paper stack contained in tray 30 to arrive in register with the image pattern on the drum. An electrostatic transfer member 79 effects transfer of the loosely held particles from the image pattern on the master sheet 75 to the copy sheet 33. Here again the image may be transferred by using an adhesive surface on the copy sheet. The copy sheet then continues beneath fuser 27 before dropping into receiving tray 40.

As can be appreciated, and as has been already mentioned above as a variation of this latter embodiment, the original document can per se comprise a master pattern for mounting onto the drum 29. That is, when the system is optically correct, or when the image is subsequently developed without transfer on the top side of copy sheet 33 in the manner shown in Fig. 1e, the transfer step shown in Fig. 3c can be eliminated.

As a still further variation of this latter embodiment in order to obtain an optical reversal of the image characters on the document 70 they are formed on the backside thereof by a backfacing carbon-like sheet or the like. Spirit duplicating master sets are conventionally prepackaged in this manner such that an ordinary typewriter ribbon can be used in the preliminary image forming step. For these purposes the carbon-like sheet would include an incorporated magnetic ink as above. The document is then processed as in Figures 3b, d, and e omitting the transfer step illustrated in Fig. 3c.

By the above description there is disclosed a duplicating process that is both simple and expedient, yielding high volume duplicating of image reproductions at relatively low unit costs.

WHAT WE CLAIM IS:—

1. An image duplicating process comprising the steps of forming a magnetic image pattern of permanently magnetized marking material, or of magnetizable marking material which is then magnetized, on the surface of a first support member, and subsequently using the magnetic field derived solely from said magnetic image pattern to attract magnetically attractable marking material towards said magnetic image pattern into image configuration either on a second support member which is brought into contact with the first support member, or directly on the image pattern on the first support member for transfer to the second support member.

2. The process according to claim 1 in which the magnetic field of the image pattern passes through the second support member to attract the magnetically attractable marking material, and the marking material is permanently fixed to the surface of the second support member before the

second support member is separated from the first support member.

3. The process according to claim 1 in which the magnetically attractable marking material is attracted directly onto the image pattern on the first support member, and is subsequently transferred to the second support member and permanently affixed thereto.

4. The process according to any one of claims 1 to 3 in which the step of forming a magnetic image pattern is accomplished by typing image characters with a ribbon of impregnated magnetic ink.

5. The process according to claim 3 in which the magnetic image pattern formed by typing on a sheet which constitutes the first support member and which is backed by a reversed carbon sheet consisting of a material having magnetic properties thereby creating a magnetic reverse image on said sheet and the magnetically attractable marking powder is attracted to the carbon image and subsequently transferred to the second support member.

6. The process according to claim 1 comprising the steps of creating xerographic images on a first support member with magnetizable powder, subjecting the powder images to a magnetic field to thereby magnetize the powder material, fusing the images to the surface of the support member, bringing a second support member into contact with the surface of the first support member containing the magnetized images and presenting a

magnetically attractable powder to the surface of the second member to thereby develop reproductions of the xerographic images by the magnetic powder being attracted to the magnetized images, and fusing the images of magnetically attractable material to the second support to render the reproduction permanent.

7. The process according to claim 1 comprising the steps of creating an image of an original copy to be reproduced with magnetizable powder on a first support member, subjecting the image to a magnetic field thereby magnetizing the powder material, fusing the image to the surface of the first support member, presenting a magnetically attractable powder to the surface of the first support member to thereby produce a second powder image of the original copy by the attraction of the magnetically attractable powder to the magnetic image, transferring the second powder image to an intermediate surface, and transferring the second powder image from the intermediate surface to a second support member for fusing thereto to produce a permanent reproduction of the original copy.

8. An image duplicating process substantially as hereinbefore described with reference to the accompanying drawings.

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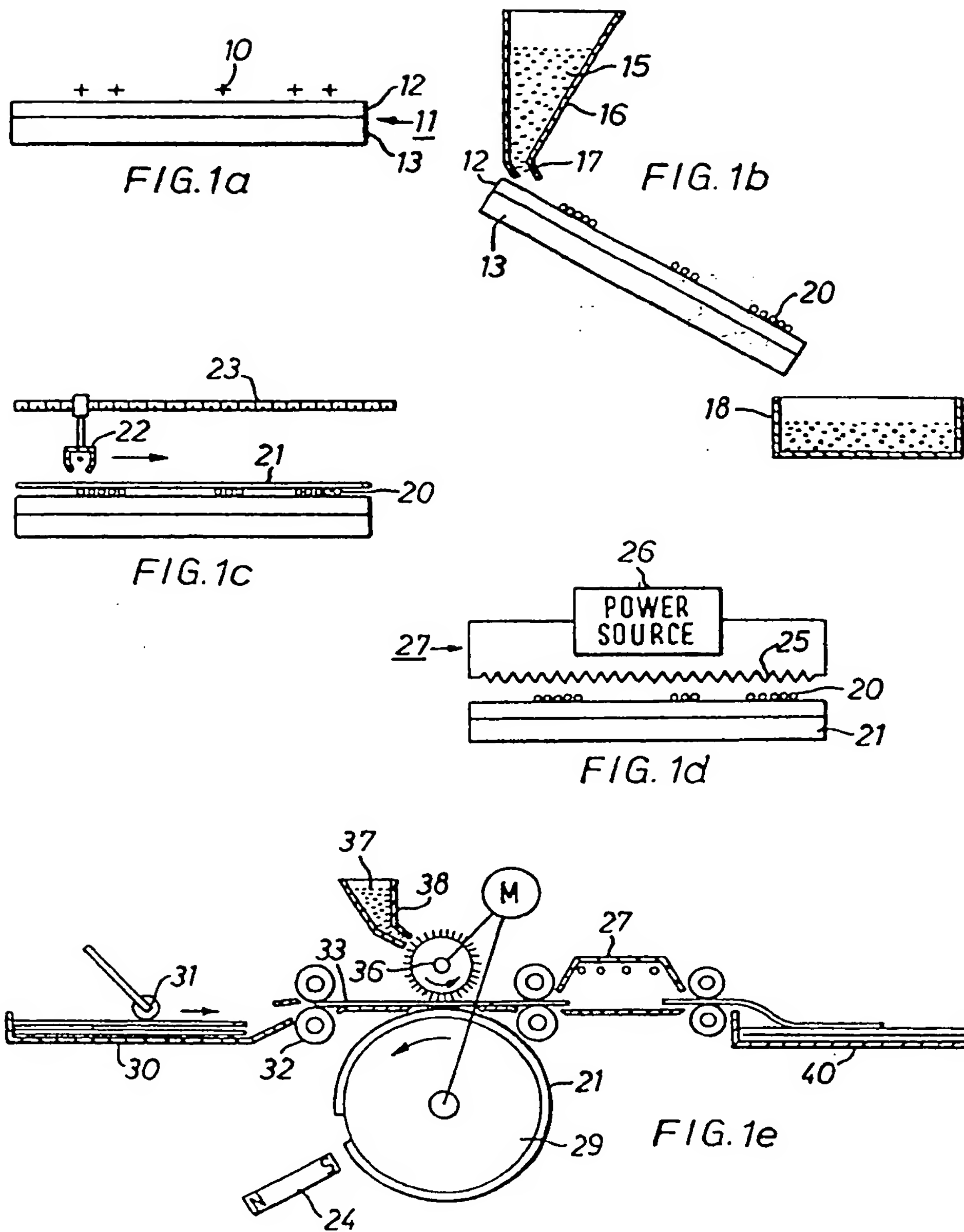
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COMPLETE SPECIFICATION

3 SHEETS

This drawing is a reproduction of
the Original on a reduced scale.

SHEET I

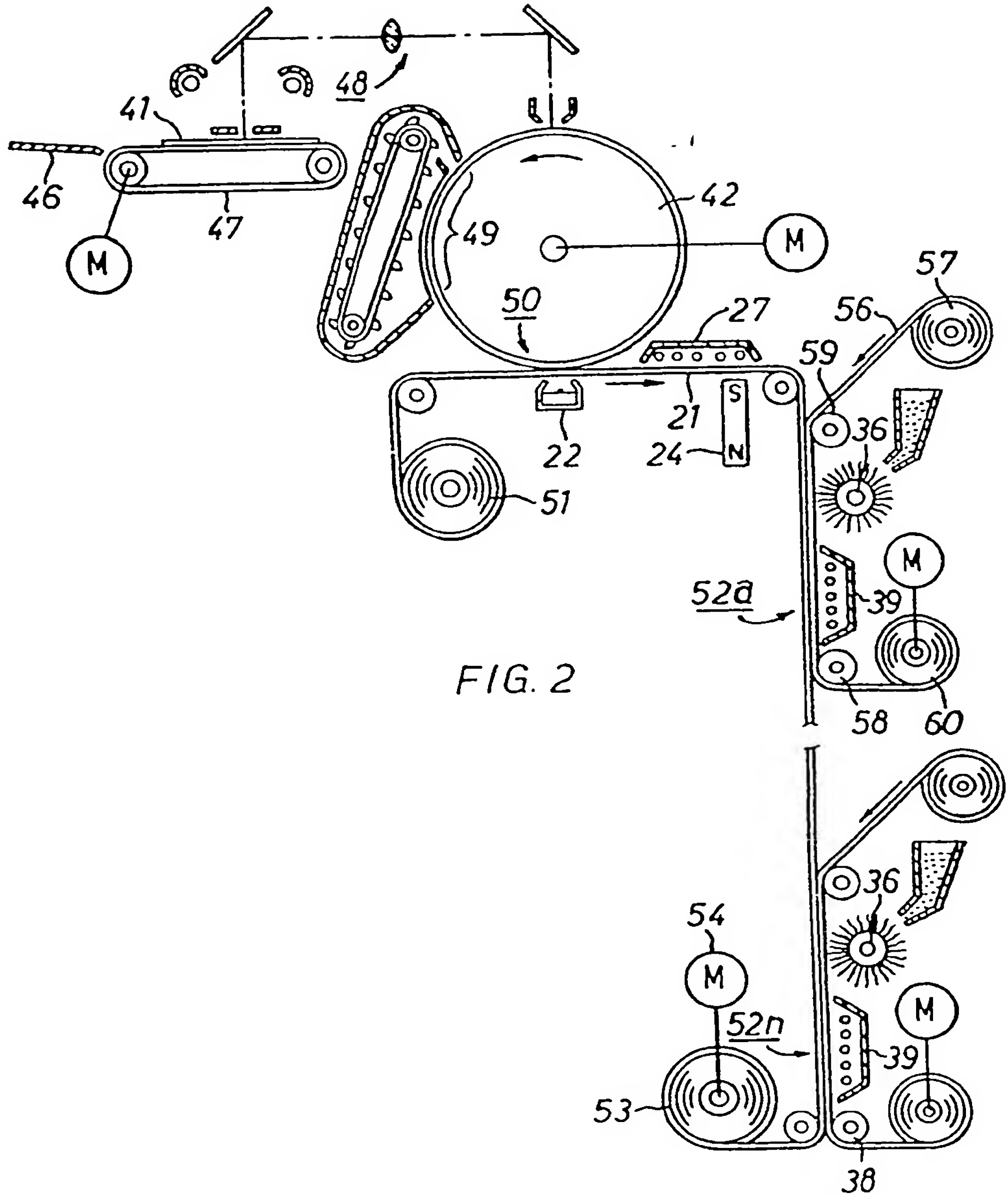


1,208,307 COMPLETE SPECIFICATION

3 SHEETS

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SHEET 2



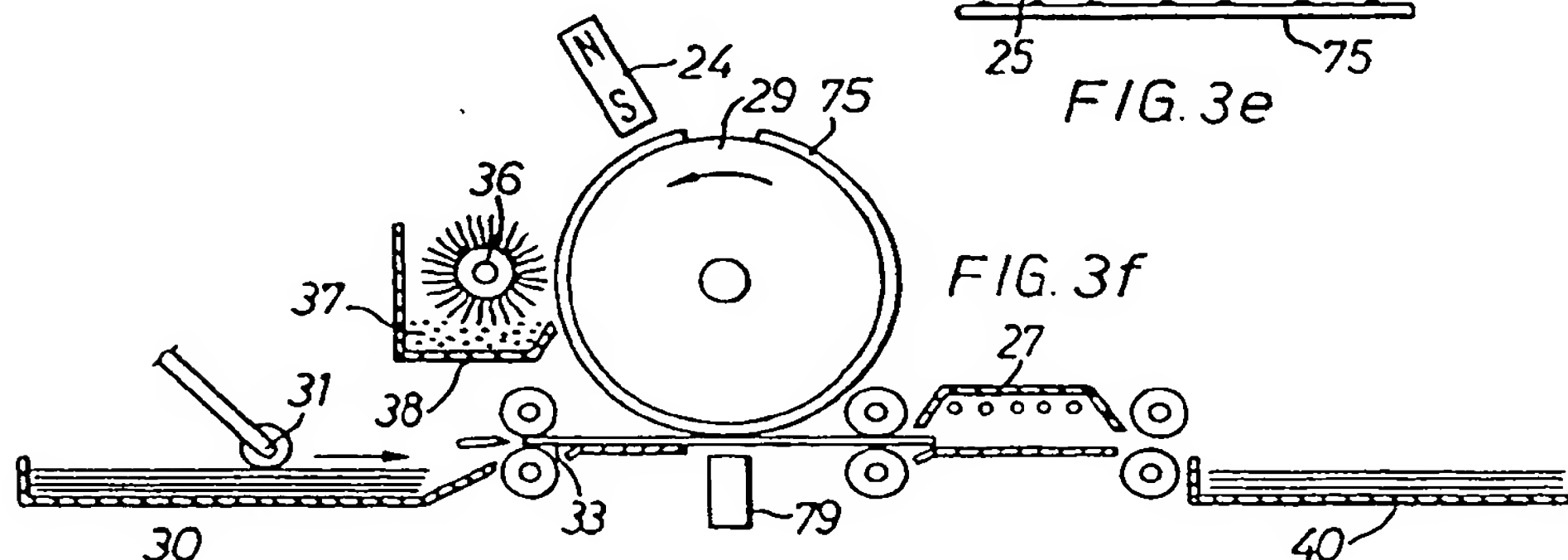
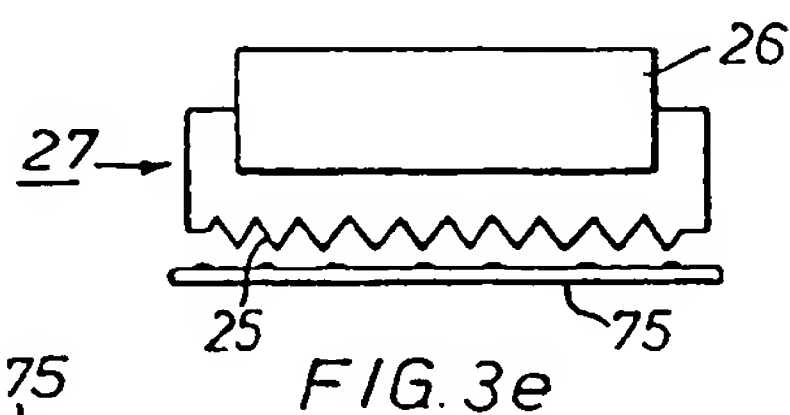
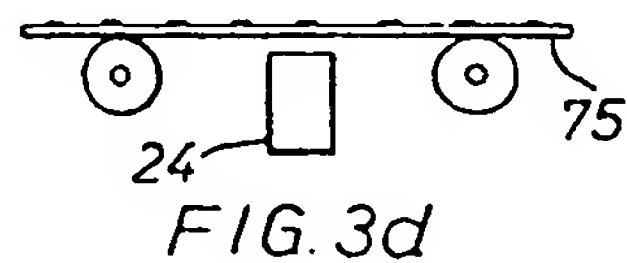
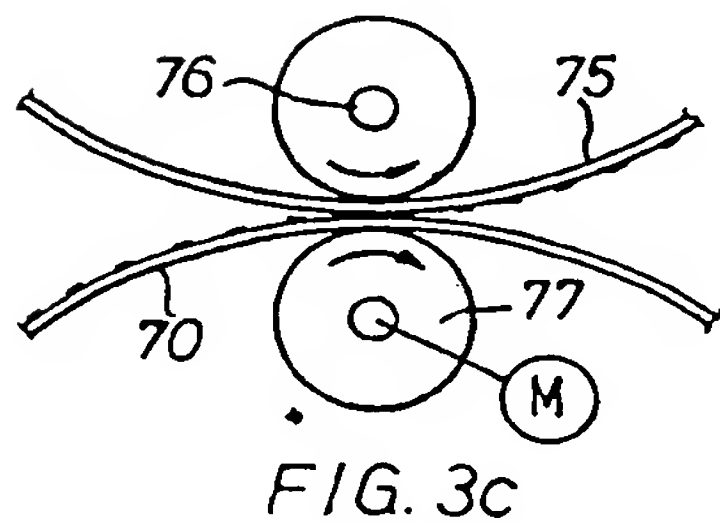
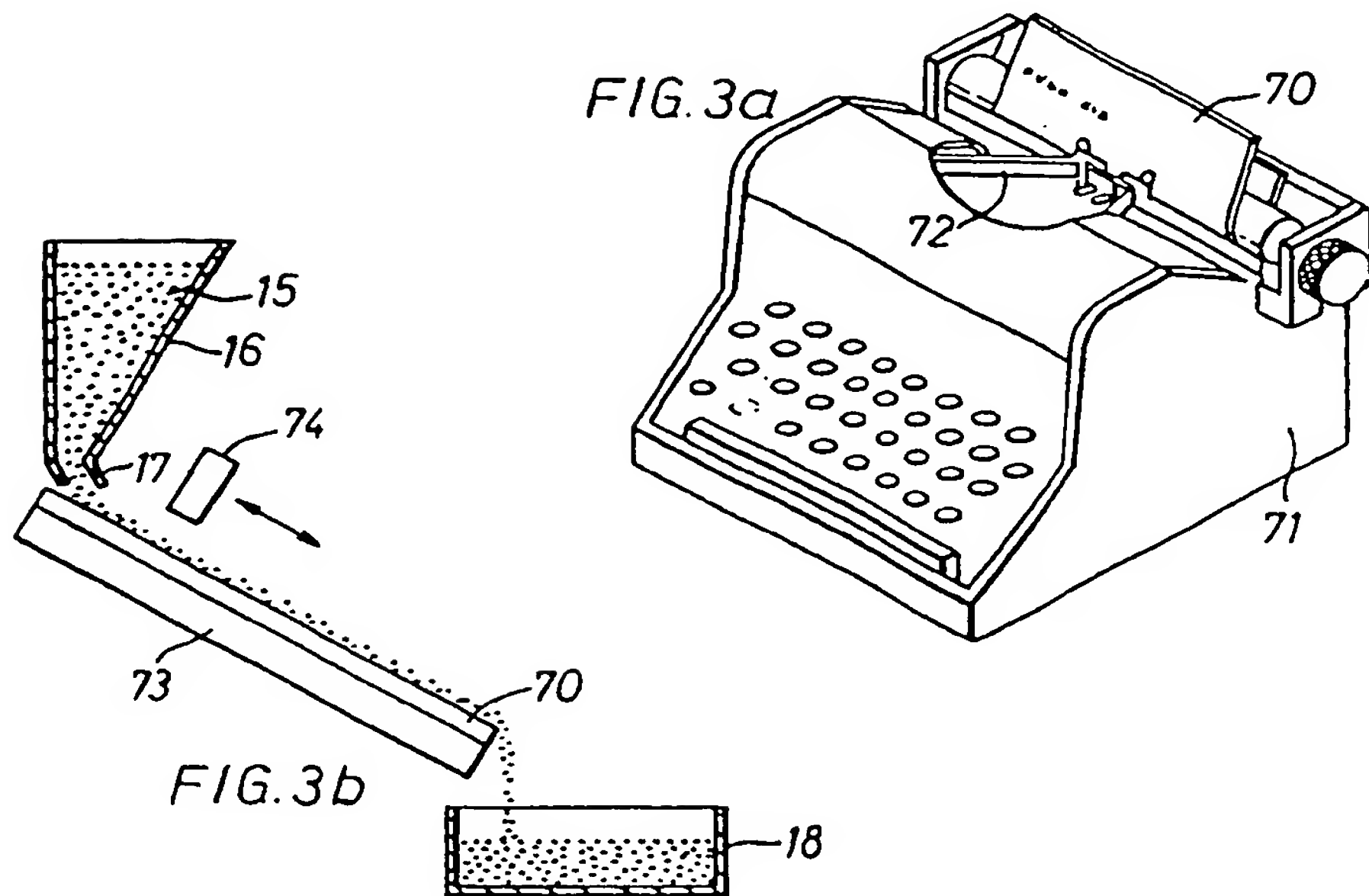
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COMPLETE SPECIFICATION

3 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

SHEET 3



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